BEBR
FACULTY WORKING PAPER NO. 89-1585

Auditor Configural Information Processing in Control Risk Appraisal

Clifton E. Brown
Ira Solomon

College of Commerce and Business Administration
Bureau of Economic and Business Research
University of Illinois Urbana-Champaign

FACULTY WORKING PAPER NO. 89-1585

College of Commerce and Business Administration

University of Illinois at Urbana-Champaign

August 1989

Auditor Configural Information Processing In Control Risk Appraisal

Clifton E. Brown, Professor
Department of Accountancy

and

Ira Solomon, Professor
Department of Accountancy

This research was funded by the Peat Marwick Foundation through a Research Opportunities in Auditing grant. The views expressed, however, are our own and do not necessarily reflect those of the Foundation. An earlier version of this paper was presented in research colloquia at the University of Texas (Austin), Ohio State University, Florida State University and San Diego State University. We wish to acknowledge the comments of conference/colloquia participants (especially, Urton Anderson, Bob Capettini and Charles Bailey) as well as those of Bob Ashton, Mike Gibbins, Bob Libby and our colleagues Jon Davis, John Hansa, Lisa Koonce and Fred Neumann. Lastly, Gerald Finnell and John Naughton (Peat Marwick - Chicago) made it possible for us to complete this study.

AUDITOR CONFIGURAL INFORMATION PROCESSING IN CONTROL RISK APPRAISAL

Abstract

The primary thesis of this paper is that configural (patterned) information processing is a skill which has been learned by auditors to a much greater extent than has been recognized in the scholarly literature. Further, it is contended that attributes of predecessor studies largely are responsible for the current non-configural characterization of auditor information processing. These attributes include inadequate development of the domain-specific meaning of configural processing, incomplete application of methods to detect configurality, and inappropriate interpretation of experimental results. To support these contentions, we develope a conceptual framework specific to control risk appraisal, derive hypotheses from this framework and present results from a laboratory experiment in which more complete means of detecting and interpreting configurality were employed than in prior studies. In contrast with prior audit studies, 71.3% of this study's auditor-subjects employed configural processing strategies, and 53.7% of such configural subjects employed strategies hypothesized by this study. Further, risk assessment predictions made by judgment models that excluded the term representing the auditor-subject's configural strategy resulted, in some instances, in control risk being seriously underestimated. These experimental results generally are consistent with the primary thesis. Concluding remarks discuss practice and research implications.

AUDITOR CONFIGURAL INFORMATION PROCESSING IN CONTROL RISK APPRAISAL

During the 1970s and early 1980s, many studies investigated auditors' judgments using the policy-capturing paradigm. A substantial portion of these studies were set in the context of internal control evaluation and supported various conclusions about how and how well auditors formulate judgments while appraising controls or control risk (see Ashton [1982, 1983] and Libby [1981] for reviews). In concert with process-tracing studies (e.g., Biggs and Mock [1983]) and expert-systems studies (e.g., Meservy, Bailey and Johnson [1986]), these policy-capturing studies continue to form much of the basis for contemporary views of auditor information processing in the control risk appraisal context (see also Felix and Niles [1988]).

These policy-capturing studies consistently have reported that auditors' judgment formulation is characterized primarily by independent rather than patterned cue usage and have concluded that auditors do not process information configurally. In this paper, we contend that configural information processing is a skill that many auditors have mastered to a much greater extent than has been recognized in the scholarly literature. Further, we argue that attributes of the prior research largely are responsible for the current non-configural characterization of auditors' information processing. Paramount among these attributes are inadequate development of the domain-specific meaning of configural processing, incomplete application of methods for detecting configurality and inappropriate interpretation of experimental results. To support these contentions, we present a conceptual framework that develops two configural processing strategies specific to the domain of internal control risk appraisal, derive hypotheses from this framework, and report the results of a laboratory experiment in which the hypotheses were tested. More complete means of detecting and interpreting configurality were used than in prior

studies. While not all auditor-subjects employed a configural processing strategy, our results are consistent with our fundamental thesis: configural information processing for control risk appraisals is more prevalent than previously has been recognized.

The next section of this paper presents a brief review of extant configural information processing research, while the third section presents a conceptual framework for configural information processing within the domain of control risk appraisal. Issues associated with detection and interpretation of configural information processing are discussed in the fourth section. The fifth section describes the laboratory experiment, including hypotheses derived from the prior sections, and presents experimental results. Concluding remarks, including research and practice implications, are presented in the final section.

PRIOR RESEARCH

Studies investigating configural processing have appeared in psychology, business and accounting journals. This section describes configural information processing and briefly reviews the most germane findings of this literature.

Psychology Studies of Configural Information Processing

The notion of configural processing was discussed in the psychology literature at least as far back as the early 1900s (Thorndike [1918]). It was not until the 1950s, however, that psychologists (Meehl [1954, 1957, 1959]) began to report experimental investigations of configural information processing. These early investigations provide a working definition which commonly underlies both psychology and accounting/auditing investigations of configurality. That is, configural information processing is cognition in which the pattern (or configuration) of stimuli is important to the subsequent judgment/ decision. Although typically discussed in connection with information evaluation, such

cognition could be employed during other judgment phases (e.g., information search; see Einhorn, Kleinmuntz and Kleinmuntz [1979]).

Further, the early investigations provided initial experimental results on configurality and stimulated substantial psychological research efforts during the 1960s and 1970s (see Hammond and Summers [1965], Goldberg [1968], Slovic and Lichtenstein [1971] and Slovic, Fischhoff and Lichtenstein [1977] for reviews). These studies, conducted across a wide variety of judgment contexts and tasks, reported only limited experimental evidence of configurality. Such experimental reports conflict with many experts' introspective reports that configural cue usage is an important component of their judgment formation.

One well-known example of this research is the investigation of physicians' diagnoses of benign vs. malignant gastric ulcers reported by Hoffman, Slovic and Rorer [1968]. Like most analysis of variance (ANOVA) studies, Hoffman <u>et al.</u> [1968] used the explained variance attributable to interaction terms both to detect configurality and to appraise its significance.[1] Despite being assured by radiological experts that configural processing was essential for correct ulcer diagnosis, these authors found that the <u>sum of all</u> such interaction terms only accounted for 10% of the explained variance in the physicians' judgments. Additionally, they reported that the largest single interaction explained about 1.7% of the variance and that the largest single main effect typically explained 10 to 40 times as much variance as did that single interaction. Such outcomes were interpreted as evidence of the power of linear models (Dawes and Corrigan [1974]) and the absence of significant configural cue usage.[2] The apparent conflict between the information judges introspectively report that they use and experimental findings of information usage based on the judgments themselves continued to stimulate interest in

configural information processing during the 1980s (see Anderson [1981], Camerer [1984, 1987], Edgell [1980, 1983] and Hitt and Barr [1989]).

Auditing Studies of Configural Information Processing

Configural information processing first attracted the attention of auditing researchers in the early 1970s. Working within the policy-capturing paradigm, these audit researchers, like their psychology predecessors, typically employed ANOVA designs (see, Ashton [1982, 1983] and Libby [1981] for reviews). Further, the auditing studies followed the psychology studies in that they searched for evidence of configural cue usage by examining the statistical significance of the explained variance attributable to ANOVA interaction terms. The results of the auditing studies also were similar to those reported in psychology journals; while some small, but statistically significant interactions sometimes were noted, the typical report was that main effects accounted for the overwhelming majority of explained variance. Moreover, such results were interpreted as evidence of non-configural information processing within audit judgment tasks.

The series of papers on auditors' evaluation of internal controls is the most prominent example of audit research of this type. The first such paper was reported by Ashton [1974], and while many extensions have been reported, all of these studies offered essentially the same conclusion:[3]

> " . . . on average the six main effects accounted for 80 percent of the variance in the auditors' judgments, and the 15 interactions accounted for only six percent. This suggests that the auditors acted as if they evaluated the effect of each question independently of the effects of other questions and did not rely on interactive, or configural, information processing" (Ashton [1983, p. 17]).

In addition to aggregate explained variance results, individual interaction terms in auditing studies typically have been found to explain only very small proportions of variance. Further, studies have reported low consistency between auditors with respect to

which individual interactions were significant. Ashton [1974] again serves as an example since it can be inferred from that study that the largest single interaction, which was significant for only 3 out of 63 auditors, on average, explained only about 3.6% of those subjects' judgment variance. Low explained variance attributable to interactive terms also has been reported in auditing studies outside of the control risk domain. For example, Brown [1983] reported that the sum of all interactions in his study only accounted for 5 percent of the variance in auditors' evaluations of internal audit departments. Similarly, Colbert [1988] reported that only 3% of the variance in auditors' inherent risk judgments was attributable to all of the interactions in her study.[4]

CONFIGURAL PROCESSING: A CONCEPTUAL FRAMEWORK

Because no (explicit) consideration was given to the meaning of configurality in their specific auditing contexts, prior studies do not provide definitive tests of auditor configurality. Further, lacking such consideration, it is not obvious that one should expect to observe configurality in audit contexts in general nor in the specific contexts examined in prior audit studies. In the present section, a conceptual framework is developed for configurality in the domain of control risk appraisal. This framework supports an expectation for configural processing when appraising control risk and, in subsequent sections, guides our experimental investigation of auditors' configural processing. Such guidance not only facilitates derivation of hypotheses at the level of individual interactions, but also specification of the nature (form) of such interactions.

Control Risk Appraisal

The auditor's ultimate purpose in evaluating controls is to determine the risk that the auditee's financial statements are presented in accordance with generally accepted

accounting principles (see Statement on Auditing Standard (SAS) No. 55 [AICPA 1989]). Audit logic, represented by the audit risk model (AICPA [1983]), recognizes that the probability of a material misstatement in an auditee's financial statements is jointly dependent on inherent and control risk.[5] While control risk appraisal largely is a subjective task about which researchers still know little, there are a few general concepts which apparently guide such evaluations in practice. One such concept, given the contingent nature of control interrelationships, is "compensating" (or "mitigating") control while, to a lesser extent, another such concept is "amplifying" control (see Deloitte Haskins & Sells [1978]; Libby, Artman and Willingham [1985]; and Merservy et al. [1986]). As described below, patterned information cue processing is integral to each of these control concepts.

Compensating Controls

Consider a situation in which there is a control weakness, such as the absence of adequate approvals over cash disbursements. More precisely, assume that "persons signing checks are not independent of those approving check requests and preparing the checks." To appraise the risk implications of this weakness, the auditor must not only consider the type of errors or irregularities that can occur, but he/she also must consider whether there are other controls in existence that compensate for the weakness. Two types of compensating controls are preventive controls and detective controls.

An example of a compensating preventive control would be a second separation-of-duties control such as, "all check requests are reviewed and approved by two officials, at least one of whom is independent of the person initiating the check request." Such a control likely would lead to identification of improper check requests on an ex ante basis and thereby, prevent a misstatement from appearing in the financial statements. An

example of a compensating detective control is provided by an internal audit feature resulting in ex post verification of the validity of such cash disbursement transactions. Notice that this type of control increases the likelihood that the misstatement, if present, will be detected rather that preventing the misstatement from appearing in the financial statements.

When appraising control risk, therefore, the auditor must identify and evaluate both control weaknesses and potential compensating controls. Such identification and evaluation, however, cannot be accomplished without attention to and processing of the configuration of the auditees' controls. This association between compensating controls and configural information processing can be highlighted by continuing the example and showing that, within an ANOVA framework, judgments reflecting compensating controls would be depicted as an interaction of a specific form.

Assume that there are two controls, separation-of-duties (A) and dual check signers (B). Assume further that each control has two levels; either it is present and operating effectively (level 1) or it is not present (level 0). If the separation-of-duties control were present and operating effectively (A_1), control risk would be judged as relatively low, regardless of whether the dual check signer control were present (B_1) or not (B_0). Alternatively, if the separation-of-duties control were not present (A_0), control risk would be judged to be relatively high in the absence of a compensating control. If however, the dual check signers control were present (B_1) and were to compensate for the weakness created by the absense of the separation-of-duties control (A_0), control risk would be judged to be as low as when the separation-of-duties control were present (A_1), assuming full compensation, or would be judged as somewhere between the high and low levels, assuming only partial compensation.

Such configural information processing for control risk appraisals, depicted in Panel A in Figure 1, would be represented within the ANOVA paradigm as a "negative ordinal" interaction.[6] In the present context, such an interaction occurs when one control is at least partially substitutable for the other control (i.e., one control compensates for the effect of another's absence) and the sum of the two controls' individual effects on control risk appraisals is larger than their joint effect (i.e., there are diminishing benefits from adding the second control to an existing control). The "slope" of the line labelled B_1 (i.e., the relative assessed risk when control B alone is present [A_0B_1]) depends upon the extent of compensation. Full compensation would be represented by a horizontal line while partial compensation would be represented by positive slope. Further, the relative effect of control A alone (A_1B_0) will depend upon the manner in which controls A and B, both individually and together, are perceived. For example, if control A alone were to be viewed as effective at preventing errors or irregularities as controls A and B together, the assessed risk for control combination A_1B_0 would not differ significantly from that for control combination A_1B_1. Alternatively, assessed risk for these two control combinations (A_1B_0 and A_1B_1) would differ significantly if control B were to be perceived as providing a significant incremental reduction in risk even when control A were present.

INSERT FIGURE ONE ABOUT HERE

Amplifying Controls

The possibility for internal control synergy (i.e., that two or more controls, in combination, may be more effective than would be implied by the sum of their individual effectiveness) is implicit in many textbook, CPA-firm manual, and research (Bodnar [1975], Grimlund [1982] and Srivastava [1986]) discussions of control reliability. That recognition of such control amplification requires attention to and processing of the

relevant control configuration, also can be illustrated by an example. Extending the previous example, now assume that control risk is judged to be reasonably low when there is separation-of-duties (A_1) but even lower when there is a redundant control (either preventive or detective). In such a case, anticipation of the second control may effectively cause the original control procedures to be performed with greater care and frequency (see Bodnar [1975]) than otherwise would be the case.

This type of situation is depicted in Panel B on Figure 1, and would be represented in the ANOVA paradigm as a positive ordinal interaction (see footnote 6). Such an interaction occurs when one control increases the effectiveness of another control (i.e., one control amplifies the effect of another control) and the two controls' joint effect on control risk appraisal is larger than the sum of their individual effects (i.e., there are increasing benefits, or synergy, from adding a second control to the existing control). The "slope" of the line labeled B_1 (i.e., the relative assessed risk when control B alone is present [$A_1 B_1$]) depends upon the extent of amplification. No amplification would result in a slope equal to that of the line labeled B_0, and as amplification increases, the slope of B_1 becomes increasingly positive. The relative effect of control A alone ($A_1 B_0$) will depend upon control A's perceived effectiveness. For example, if control A were to be viewed to be effective by itself, the assessed risk for control combination $A_1 B_0$ would differ significantly from that for control combination $A_0 B_0$.

Implications

One reason for the typical finding that auditors are not configural information processors when appraising control risk is implicit in the above discussion. That is, a necessary (but not sufficient) condition for configural processing to have been detected was not satisfied because prior studies did not incorporate the concepts of compensating

or amplifying controls nor were other obvious configural strategies required to respond to experimental stimuli. Examining the procedures and materials used in the prior auditing studies, one observes that both preventive and detective controls are represented. But, one also observes that no extant study captured two or more preventive control features which related to the same control objective in such a way that a weakness in one control would be, at least, partially offset by the presence of another control. Further, while a detective control in the form of internal audit often is present in prior studies, that control generally is stated in such a general fashion that the precise activities that internal audit was to have performed are not readily apparent. It is not clear, therefore, that internal audit would have been perceived as a significant detective compensating control in prior research. Finally, because the stimuli in prior studies generally related to different control objectives, it is not obvious that any such controls would have been perceived as significantly amplifying another control. One reason for prior findings of non-configurality, therefore, is that, absent control feature/objective interdependencies, substantial patterned information processing was not necessary to perform the experimental tasks. Consequently, there is no obvious reason why an auditor would have done anything other than what was observed in prior studies: evaluate independently the effect of each control.

CONFIGURALITY DETECTION/INTERPRETATION

By discussing two issues related to detecting and interpreting configural processing when ANOVA is employed, a second reason for the "non-configural" results of prior studies can be identified. The first issue focuses on ordinal interactions and the appropriateness of using the explained variance attributable to interaction terms (either absolute or relative to that attributable to main effects) as a measure of configurality.

The second issue relates to using a criterion of prediction in addition to that of explained-variance. Importantly, the ensuing discussion of these issues suggests that additional methods are necessary if researchers are to be able to appropriately detect/interpret auditor configurality.

As observed by Hoffman et al. [1968], Ashton [1974], and Dawes [1988], most judgment contexts (including auditing) are characterized by ordinal, rather than disordinal, relations between information and judgments utilizing such information.[7] ANOVA, however, has a limited ability to detect configural information processing when it is expected to be manifest as an ordinal interaction. As shown via simulation by Yntema and Torgerson [1961], for example, even when information processing is known to be configural, ANOVA will attribute virtually all of the explained variance to main effects rather than to ordinal interactions.

In Appendix A, we extend the Yntema and Torgerson simulation to a context analogous to auditor appraisal of control risk. A primary result is that there is a theoretical limit to the magnitude of an ordinal interaction's explained variance (without changing the form of the interaction to disordinal). Further, the interaction's explained variance is at a maximum when compensation/amplification is complete. When the interaction is on the "frontier" (see curve 1 on Figure 2 in Appendix A), the maximum explained variance attributable to the interaction, as well as each constituant cue, is 33.3%. When the interaction is "interior" (see, for example, curve 2 on Figure 2 in Appendix A), the explained variance attributable to the interaction decreases toward zero and that attributable to the largest of the constituent cues increases towards 100%. Thus, in most situations, the explained variance attributable to an interaction of information cues will be small not only in absolute terms but also relative to that of its constituent

cues. Many auditing ANOVA studies, however, have reacted to such a finding as if it were sufficient evidence that individuals do not process information configurally.

Second, the value of a configural judgment strategy lies in the extent of potential judgment error and associated costs that would occur if the strategy were not to be employed, rather than the explained judgment variance attributable to the strategy (see Schepanski [1983]). The explained variance attributable to a term within an individual's judgment model, however, is not a reliable indicator of the error in predicted judgments that would occur if that term were to be dropped from the model.[8] This problem arises, in our context, because explained-variance measures are scale-free, whereas measures of prediction error and associated costs are scale-dependent. When the individual's overall judgment variance is large, even judgment model terms with low explained variance can create relatively large judgment prediction errors if such terms were dropped from the model. Alternatively, when the individual's overall judgment variance is small, dropping terms with high explained variance may create relatively small judgment prediction errors. Further, the two prediction error types are not equally important when their associated costs are asymmetric. For example, the audit effectiveness costs associated with control risk understatement may be considerably larger than the audit efficiency costs associated with control risk overstatement and thus, the importance of an error that understates risk by a given amount would be greater than one that overstates risk by the same amount. Thus, prior audit research findings that interaction terms accounted for low proportions of explained variance is not sufficent evidence to conclude that such terms are unimportant or that auditors do not process information configurally.

EXPERIMENT

Essential features of the experiment and details of the results are described in this section. While, to enhance comparability of results, many features were similar to those of prior auditing studies, the present experiment differs in some important respects from predecessor experiments. Most noteworthy is that: 1) the previously described conceptual framework guided our research design (including case development and hypothesis specification) and 2) both prediction and explained-variance measures were used to detect and interpret the auditor-subjects' configural information processing.

The Control Risk Appraisal Case

Based on the earlier conceptual framework, a case was developed in which configural information processing would be consistent with fundamental domain-specific auditing knowledge. The specific context was appraisal of control risk for a portion of a company's cash disbursement controls. The case included background and detailed information concerning controls (presented in Appendix B), and sample stimuli presentations.

Subjects were told that they would be presented with a series of cash disbursements control questionnaires (completed by an auditor on their staff) and asked to assess a specified control risk. An example of the cash disbursement control questionnaire is presented in Exhibit 1. Question number four (a, b, and c jointly) is a separation-of-cash-disbursements-duties control. Question number five is a preventive control and question number six is a detective control. Five of the six questions (numbers 1, 3, 4b and 4c jointly, 5 and 6 in Exhibit 1) were factorially manipulated at two levels each (Yes or No), and two questions (2 and 4a in Exhibit 1) were held constant (Yes).

INSERT EXHIBIT 1 ABOUT HERE

For each control questionnaire, subjects were asked to assess the following control risk (elicited on a 100-point scale where 0 was no risk and 100 was maximum risk):

> Given the controls as represented above, assess the RISK that cash disbursements could be materially misstated AS A RESULT OF checks being written and/or disbursed for improper (unauthorized and/or invalid) purposes.

Hypotheses

Most prior studies have measured configural processing as the <u>sum</u> of the explained variance attributable to <u>all possible</u> interactions. For comparative purposes, therefore, the following alternative-form hypothesis is expected to hold:

H1: The percent of auditors having significant control risk assessment variance attributable to interactions of relevant controls will be significantly greater than zero.

The earlier conceptual framework for control risk assessment, in concert with the preceding discussion of methods, support derivation of hypotheses at the level of individual interactions and specification of the form of such interactions. The following alternative-form hypotheses are expected to hold:

H2: For auditors having significant control risk assessment variance attributable to interactions of controls:

a. The proportion with a significant interaction of a separation-of-duties control and an appropriate preventive control will be significantly greater than zero.

b. The proportion with a significant interaction of a separation-of-duties control and an appropriate detective control will be significantly larger than zero.

H3: The form of the interactions predicted in hypothesis two either will be negative ordinal (i.e., compensating a separation-of-duties weakness) or will be positive ordinal (i.e., amplifying a separation-of-duties strength) as evidenced by the following attributes:

a. For negative ordinal interactions;

(1) Assessments of control risk will be signficantly larger when both controls are absent than when only a single control is present.

H3: Continued.

(2) Reflecting diminishing benefits for multiple controls, the difference in assessments of control risk when the separation-of-duties control is absent (and the preventive/detective control is either present or absent) will be significantly larger than that when the separation-of-duties control is present (and the preventive/detective control is either present or absent).

b. For positive ordinal interactions;

(1) Assessments of control risk will be significantly smaller when both controls are present than when only a single control is present.

(2) Reflecting increasing benefits for multiple controls, the difference in assessments of control risk when the separation-of-duties control is present (and the preventive/detective control is either present or absent) will be significantly larger than that when the separation-of-duties control is absent (and the preventive/detective control is either present or absent).

H4: Judgment models containing all significant terms will produce prediction errors that are significantly smaller than those produced by models which exclude the significant interactions of internal controls predicted by hypothesis two.

Research Design

The research design was a one-half fractional replication of the factorial manipulation of the five cash disbursement control questions identified earlier (the defining contrast was the 5-way interactions). An ANOVA was computed for each subject's risk assessments. Although each ANOVA estimated all main effects (5) and two-way interactions (10), the higher-order (three, four and five-way) interactions are aliases of the estimated effects and thus, are assumed to be negligible.[9] In addition, since such ANOVAs are determined fully (i.e., the percent of explained risk assessment variance for the estimated effects will equal 100 percent), there is no error estimate (i.e., error sum of squares will equal zero). Results of a pilot study employing a full 2^5 ANOVA design,

however, indicated that effects $\geq 2\%$ explained risk assessment variance were significant.[10] Consequently, for the present one-half replication design, a level of $\geq 4\%$ explained risk assessment variance was used as the significance criterion (i.e., terms with less than 4% explained variance were assumed to have been caused by random variation rather than systematic effects).

Dependent Variables: Judgment Evaluation Criteria

Two criteria were used to evalute subjects' ANOVA judgment models: percent of explained judgment variance and judgment model prediction differences. The percent of explained judgment variance for each term within a subject's ANOVA model was computed by dividing the sum of squares for the term by the total sum of squares for the model. Judgment model prediction differences were computed by first constructing two judgment models for each subject: a full model containing all above-criterion (i.e., $\geq 4\%$ explained variance) terms and a reduced model which was the same as the full model except that it excluded the hypothesized interactions. For each subject, both models were then used to predict the half-replication cue combinations that were <u>not</u> used to fit the models. Judgment model prediction difference was computed as the control risk predicted by the reduced model minus the control risk predicted by the full model.

Subjects and Procedures

Subjects were 94 audit seniors with 3 to 4 years of audit experience. The subjects were employed by the same national CPA firm, and participated either at their office or while attending the firm's advanced in-charge course. The experiment laboratory session consisted of two sections, training and experiment. Both sections were presented on

personal computers, and subjects completed the sections at their own pace (on average, approximately 36 and 22 minutes per training and per experiment section, respectively).

The training section began with brief instructions on the personal computer, and was followed by a control risk case involving inventories. Each subject evaluated four manipulations of the practice inventories case to gain familiarity using the response scale and two decisions aids available in the experiment section.[11] The experiment section began with presentation of background information concerning the case, and was followed by a blank copy of the case's control questionnaire, additional instructions[12] and additional specific information.[13] The subjects then responded to a series of questions designed to stimulate prior thought about relations between the items listed on the questionnaire and the specific control objectives for which they were being asked to make risk assessments.[14]

Following these series of questions, the subjects were presented sequentially with the 16 questionnaires from one of the half-replications (randomized over subjects). The order of the questionnaires (i.e., the cue combinations) within each half-replication was randomized for each subject. In addition, the order of the items on the questionnaires were counterbalanced; one-half of the subjects received one order and the other one-half received a second order.[15] Finally, subjects responded to a post-experimental questionnaire.

Results

Configural Cue Usage as the Sum of Interactions. As indicated in Table 1, 67 of the 94 subjects responding to the control case (71.3%) exhibited at least one interaction with explained risk assessment variance in excess of the 4% significance criterion. A 95%

confidence interval for this proportion is ±9.2% (i.e., 62.1% to 80.4%), which does not include zero. Thus, hypothesis one is supported.

INSERT TABLE 1 ABOUT HERE

The magnitude of explained risk assessment variance attributable to above-criterion interactions averaged 10.69% over the 67 subjects, which is significantly greater than zero ($t[66] = 13.52$, $p<.01$). Similar to prior research results, the explained judgment variance attributable to above-criterion main effects averaged 83.2% over all 94 subjects (80.2% over the 67 subjects) and thus, total above-criterion explained variance averaged 93.89% over all subjects (90.89% over the 67 subjects).

Configural Cue Usage as Specific Interactions. As indicated in Table 1, explained risk assessment variance for 27 of the 67 subjects (40.3%) exhibited an above-criterion interaction for the predicted preventive by separation-of-duties controls (CD in Table 1). A 95% confidence interval for this proportion is ±11.7% (i.e., 28.6% to 52.0%) , which does not include zero. The detective by separation-of-duties controls accounted for an above-criterion portion of explained risk assessment variance for 12 of the 67 subjects (17.9%). A 95% confidence interval for this proportion is ±9.2%, which also does not include zero. These results support hypotheses 2a and 2b.

The magnitude of risk assessment variance explained by the above-criterion predicted interactions averaged 7.41% for the preventive interaction and 6.92% for the detective interaction. Both means are significantly greater than zero ($t[26] = 11.88$ and $t[11] = 9.04$; both $p<.01$), and over all 67 subjects, the two predicted interactions account for 39.5% of explained risk assessment variance attributable to all ten interactions.

Form of Specific Interactions. All above-criterion predicted interactions were well-formed with respect to the auditing concepts discussed earlier and thus, confirm

hypothesis three. For the 39 above-criterion predicted interactions (CD and CE in Table 1), 19 (48.7%) were compensating for a separation-of-duties weakness (i.e., a negative ordinal interaction) and 20 (51.3%) were amplifying a separation-of-duties strength (i.e., a positive ordinal interaction). Interestingly, most (59.3%) of the above-criterion preventive interactions were compensating, whereas most (75%) of the above-criterion detective interactions were amplifying.

The mean risk assessments for each form of the hypothesized interactions are presented in Table 2. Starting with the compensating form, a one-way repeated measures ANOVA indicated that the mean risk assessments between the interactions' treatment levels differed significantly ($F[3,225] = 109.2$; $p<.01$). Tukey's test over these levels (the critical difference at $p=.01$ was 8.26) indicated that the mean risk assessments were signficantly higher when neither control was present (NN in Table 2) than when either (or both) controls were present (NY, YN and YY in Table 2). In addition, there are diminishing benefits to adding the preventive/detective control to an existing separation-of-duties control as evidenced by the sum of the controls' individual effects on control risk assessments being larger than their joint effect (the difference is 21.0 and a planned comparison $t[225] = 5.6$; $p<.01$). Together, these results verify the two attributes required for negative ordinal interactions (see hypothesis 3a).

INSERT TABLE 2 ABOUT HERE

For the amplifying form, another one-way repeated measures ANOVA indicated that the mean risk assessments between the interactions' treatment levels differed significantly ($F[3,237] = 83.8$; $p<.01$). Tukey's test over these levels (the critical difference at $p=.01$ was 8.45) indicated that the mean risk assessments was signficantly smaller when both controls were present (YY in Table 2) than when either control was

present singly or both controls were absent (NY, YN and NN in Table 2). In addition, there are increasing benefits to adding the preventive/detective control to an existing separation-of-duties control as evidenced by the sum of the controls' individual effects on control risk appraisals being smaller than their joint effect (the difference is 21.2 and a planned comparison t[237] = 5.5; p,.01). Together, these results verify the two attributes required for positive ordinal interactions (see hypothesis 3b).

Judgment Model Prediction Differences. Full and reduced judgment models were formed for the subjects who had at least one hypothesized interaction (CD and CE in Table 1) that was above-criterion and well-formed. The risk assessments predicted by these judgment models are presented in Table 3 (for those models with compensating interactions) and Table 4 (for those models with amplifying interactions). Overall, the mean absolute difference between the full and reduced model predictions within each level of the hypothesized interaction was 5.35 for compensating forms and 5.29 for amplifying forms. These prediction differences are significantly greater than zero (t[18] = 13.1 and t[19] = 9.7; both $p<.01$), thus supporting hypothesis 4.

Further, the absolute risk assessment differences between judgment models ranged from 10.19 to 2.81 and from 10.0 to 0.94, and the mean for the upper quartile ($n=5$) of differences is 7.54 and 8.73 for the compensating and amplifying forms, respectively. For the compensating form, this difference appears especially critical when both controls are present. In this level, the full model predicts control risk to be 12.55, whereas the reduced model, underestimating by 60.1%, predicts control risk to be 5.01.

INSERT TABLES 3 AND 4 ABOUT HERE

Explained Variance Related to Predictive Ability. Earlier, an argument was made that knowledge of a factor's (i.e., cue or cue pattern) explained variance does not

necessarily imply knowledge of that factor's predictive ability. For the 39 hypothesized interactions that were above-criterion and well-formed, the correlation between the explained variance criterion (i.e., the proportion of judgment variance attributable to the interaction) and the predictive ability criterion (i.e., the absolute magnitude of judgment model prediction difference caused by dropping the interaction from the model) was 0.503. That is, only 25.3% of the variance in one criterion can be predicted from the knowledge of the other criterion. An extreme example of the lack of perfect correlation is a subject who had only 4.59% explained variance attributable to an hypothesized interaction (30th out of 39 in size), was ranked 8th out of 39 in size given his (her) judgment model prediction difference of 6.88. Similarly, another extreme example is a subject who had 12.87% explained variance attributable to an hypothesized interaction (4th out of 39 in size), had a judgment model risk assessment prediction difference of only 4.88 (22nd out of 39 in size).

DISCUSSION AND CONCLUDING REMARKS

From the perspective of the explained variance criterion, the experimental results indicate that a substantial proportion of the auditor-subjects processed information configurally. Further, the average explained variance for the hypothesized interaction of the separation-of-duties and the preventive controls is about twice that of the largest single (unhypothesized) interaction in prior auditing studies (e.g., 7.41% versus about 3.6% in Ashton [1974]), and is larger than the cumulative explained variance of <u>all</u> interactions in most such studies (e.g., just over 6% in Ashton [1974]). Similar statements can be made about the magnitude of the hypothesized interaction of the separation-of-duties and the detective controls.

Evidence based on the prediction criterion also suggests the import of configural processing and thus, complements the explained variance evidence. Judgment models that excluded the hypothesized interactions predicted control risk assessments that are significantly different from the prediction of similar models that included such interactions. This especially is the case for the compensating (negative ordinal) interactions because the reduced models failed to fully reflect that diminishing risk reduction would result from the addition of the second control. Thus, the reduced models (vis-a-vis the full model), seriously underestimate the risk that, in the context of the present study, cash disbursements could be materially misstated due to checks being written and/or disbursed for unauthorized or invalid purposes. Further, the consequences of such underestimation may be severe since diminished audit effectiveness can result.

These results suggest that the general characterization of auditors as non-configural information processors may be incorrect. That is, many auditors apparently are able to react to and process patterns of information when such reaction and processing makes sense from an auditing perspective. Futher, computer audit judgment models and decision aids now are being introduced into practice. The judgment policies to be reflected in such models, however, should consider the issues concerning configural information processsing raised in this study rather than assuming that configurality does not exist or is unimportant.

Using control-specific concepts, two specific configural processing strategies (compensation and amplification) were identified and distinguished. We are unaware of a prior study, in any domain, in which specific configural processing strategies have been successfully delineated. Although specific strategies were anticipated, a relatively large portion of the auditor-subjects apparently did not employ a configural strategy. Given the rather basic control concepts which underlie such configural processing, therefore,

interesting questions for further research are, "Why do some auditors employ what apparently are configural strategies when appraising control risk while other auditors do not?" and "Why do some auditors employ compensating configural processing strategies when others employ amplifying strategies?" Related to these questions is, "What conditions facilitate development of auditors' ability to process information configurally?" These questions indictate the importance of future research on the role of knowledge and structure of memory in developing expertise (cf., Frederick and Libby [1986] and Libby and Frederick [1988]).

Finally, additional research using different methods is needed. For example, the ANOVA-based methods of the present study are paramorphic; judgment processes are inferred through the analysis of judgments. Studies employing research methods such as process tracing and verbal protocol analysis would complement the present study by providing more direct evidence on the cognition actually employed by auditors to assess control risk.

APPENDIX A

SIMULATIONS OF CONFIGURAL INFORMATION PROCESSING WITHIN A TWO-CUE CONTEXT

Control risk assessments were simulated within a context, analoguous to that of Figure 1, in which they have continuous values ranging from zero to 100. Available were two information cues, A and B, representing environmental variables of import for control risk assessment. Each cue had two levels, presence (level 1) and absence (level 0). Two forms of ordinal interactions were simulated: a negative ordinal interaction in which cue B's presence compensated for the effect on control risk assessments of cue A's absence, and a positive ordinal interaction in which cue B's presence amplified the effect of cue A's presence. Two simulations were performed for each interaction form in which the assessed control risk given the presence of both cues (A_1B_1, which is the situation in which control risk should be at a minimum) was set equal to ten, and the assessed control risk given the absence of both cues (A_0B_0), which is the situation in which control risk should be at a maximum) was set equal to 90. The control risk assessments for the other information cue combinations depended upon the interaction form. For negative ordinal interactions (compensating), control risk assessments given:

1. the presence of cue A in combination with the absence of cue B (A_1B_0) were set equal to ten for the first simulation (curve 1) and 25 for the second simulation (curve 2); and

2. the presence of cue B in combination with the absence of cue A (A_0B_1) were manipulated over the range of ten to 90 for the first simulation (curve 1), and 25 to 90 for the second simulation (curve 2).

For positive ordinal interactions (amplifying), control risk assessments given:

1. the presence of cue A in combination with the absence of cue B (A_1B_0) were manipulated over the range of ten to 90 for the first simulation (curve 1), and 25 to 90 for the second simulation (curve 2); and

2. the presence of cue B in combination with the absence of cue A (A_0B_1) were set equal to 90 for the first simulation (curve 1), and 75 for the second simulation (curve 2).

INSERT FIGURE 2 ABOUT HERE

Given these parameters, Figure 2 presents simulation results in which the control risk assessment variance attributable by a 2 x 2 ANOVA to each cue's main effect is graphed as a function of that attributable to the two cues' interaction. Results for the negative and positive ordinal interaction simulations were identical. Thus, curve 1 and curve 2 depict the first and second simulation results, respectively, for both interaction forms.

To illustrate how the graph in Figure 2 should be read, examine the dashed lines. Focussing on the first simulation (curve 1), if the ANOVA model were to attribute approximately 15% of the control risk assessment variance to the interaction of cues A and B, 70% of the control risk assessment variance would be attributed to the main effect of cue A and 15 % would be attributed to the main effect of cue B. Focussing on the second simulation (curve 2), if the ANOVA model were to attribute the same level of risk assessment variance to the interaction of cues A and B (i.e., 15%), approximately 47% of the risk assessment variance would be attributed to the main effect of cue A and 38% to the main effect of cue B.

Conceptually, the first simulation (curve 1 in Figure 2) represents either various degrees of compensation of cue B for cue A with no marginal benefit for the presence of both cues over the presence of cue A alone (for negative ordinal interactions), or various degrees of amplification of cue A by cue B with no benefit for the presence of cue B in the absence of cue A (for positive ordinal interactions). This simulation depicts the frontier of the relationships (i.e., the right-most curve) between the explained control risk assessment variance attributed by the ANOVA model to its three constituant components

(cue A, cue B and their interaction). On this frontier, the maximum explained control risk assessment variance attributable to the interaction of the cues is 33.3%, and that attributable to each main effect at this point also is 33.3%. Moving back (to the left) along this curve, the explained risk assessment variance attributable to cue A's main effect increases, and that attributable to both cue B and the interaction of cues A and B decrease (but remain equal to each other).

Conceptually, the second simulation (curve 2 in Figure 2) represents either various degrees of compensation of cue B for cue A with <u>some</u> marginal benefit for the presence of both cues over the presence of cue A alone (for negative ordinal interactions), or various degrees of amplification of cue A by cue B with <u>some</u> benefit of cue B in the absence of cue A (for positive ordinal interactions). All such situations (without changing the form of the interaction from ordinal to disordinal) will result in curves that are to the left of curve 1 on Figure 2. On these "interior curves," the maximum explained risk assessment variance attributable to the interaction of the cues will lie on the solid, negatively-sloping line separating the cue A and cue B curves on Figure 2, and will be <u>smaller</u> than that for curve 1 (e.g., the maximum for curve 2 is approximately 17%). Moving back (to the left) along an interior curve, the explained risk assessment variance attributable to cue A's main effect increases, and that attributable to both cue B and the interaction of cues A and B decrease. The explained risk assessment variance attributable to each cue's main effect, however, always will be greater than or equal to that attributable to their interaction.

APPENDIX B

CASH DISBURSEMENTS INTERNAL CONTROL CASE

Assume you are a senior-level auditor and that one of your clients is Nortack, Inc. Nortack, a large processor and merchandiser of agricultural commodities, is a privately-held company that has debt covenants requiring audited financial statements prepared in accordance with GAAP. The company has not presented significant auditing problems during your firm's five-year tenure as its public auditor. Nortack's management is actively involved both in designing the company's internal controls, as well as reviewing existing internal controls. The employees who administer Nortack's internal controls are well trained and supervised, with clearly defined responsibilities. Nortack has relatively autonomous internal audit department that is adequately staffed and supervised; the department head was a manager for a Big-8 CPA firm, and most of the internal auditors have CPA certificates. During the past five years, Nortack has been computerizing its accounting and information systems.

Currently, you are planning Nortack's 1988 audit engagement and are evaluating its internal controls to determine the extent to which you will rely on them in planning the year-end audit work. For 32 randomly ordered cases, you will be presented with a portion of a cash disbursement internal control questionnaire completed by an auditor on your staff. For each case, you will be asked to assess the risk that the specified controls could give rise to a material misstatement of cash disbursements AS A RESULT OF checks being written and/or disbursed for improper (unauthorized and/or invalid) purposes.

Additional cash disbursement controls information:

A. The authorization for approving expenditure requests has been designated by the Board of Directors at various management levels, depending upon the nature and amount of the request. Expenditure authorization is indicated on purchase orders.

B. The cash disbursement department has the responsibility for verifying the propriety of expenditures and for recording them in the voucher register. The original copy of the voucher has a copy of the vendor's invoice, receiving report and purchase order attached.

C. Primary check signers carefully scrutinize vouchers and supporting documentation at the time checks are signed.

D. WHEN THEY EXIST, second check signers are independent of all other expenditure and cash disbursement functions.

FOOTNOTES

1. The measure of explained variance used typically has been the omega-squared statistic (see Ashton [1982]).

2. While psychology studies generally have failed to detect configurality, there are a few exceptions. Examples in which such configurality was reported include studies of stockbrokers' judgments (Slovic [1969]), psychiatric medical professionals (Rorer, Hoffman, Dickman and Slovic [1967]), and studies of moral judgment (Leon, Oden and Anderson [1973]). Similarly, Einhorn et al. [1979] have noted that process-tracing models suggest that information search often is configural. Further, Anderson [1981, 1982] has argued that a lack of response scale linearity may have masked configurality in many psychology studies.

3. For example, see Ashton and Kramer [1980], Ashton and Brown [1980], Hamilton and Wright [1982], Reckers and Taylor [1979], Hall, Yetton and Zimmer [1982] and Trotman, Yetton and Zimmer [1983].

4. Still other studies couched in accounting contexts have reported similar non-configural results (see Libby [1975] and, for reviews, Libby [1981] and Ashton [1982]).

5. Inherent risk is the propensity for errors and irregularities to occur which would result in material misstatement, and control risk is the probability that such errors and irregularities will not be either prevented or detected by the auditee's control system.

6. Interactions can be categorized by the relationship between constituent information cues and resulting judgment/decisions: either conditionally monotonic or not. Conditionally monotonic relationships require that higher (or lower) values of one constituent cue imply higher (or lower) judgment/decision values, regardless of the values of the other constituent cues (see Dawes and Corrigan [1974]). Interactions that are conditionally monotonic are referred to as <u>ordinal</u>, and those interactions that violate conditional monotonicity are referred to as <u>disordinal</u> (cf., Kerlinger [1986]). The term <u>negative</u> refers to situations in which there is a greater effect on judgments when one control is added to a condition of neither control being present, then when one control is removed from a condition of both controls being present. The term <u>positive</u> refers to situations in which the reverse occurs.

7. That is, each information cue, independent of other cues, is monotonically related to the judgments of individuals who utilize them.

8. Prediction error, in this study, is defined to be the difference between predictions by a general linear model of an individual's judgments made both with and without the term in question. Since overall mean prediction error could mask offsetting error types, such errors should be examined within the levels of the term in question.

9. Pilot study results in which full (non-fractional) ANOVA's were estimated indicated no significant three, four or five-way interactions (n = 16).

10. The higher-order (three, four and five-way) interactions were used as estimates of error.

11. The two decision aids were an electronic file and a logical consistency checker. When assessing risk, the subject had access to an electronic file of questionnaires that he (she) had already evaluated. Previous evaluations could not be changed. As the subject worked through the questionnaires, the computer reviewed the assessments for logical consistency (i.e., dominance conditions). If the computer detected an apparent logical inconsistency, that fact was displayed and the subject had the option of either changing or maintaining his (her) assessment of the current questionnaire.

12. The subjects were instructed to ignore the temporal sequence of the questionnaires, and that these questionnaires would provide a mixture of possible situations. Further, the subjects were told that although in actual practice some situations may occur less frequently than others, they should not allow such frequency to affect their risk assessments.

13. The additional information concerned the company's cash disbursement controls and is described more fully in Appendix B.

14. For each listed cue, the subject was asked to think about things that could go wrong or misstatements that could go undetected if the control were not present. The subject was asked to write these thoughts down and to indicate the control's importance for achieving the specified audit objective.

15. Subjects participated in two of three experiments in the same sitting. Using random assignment, some subjects were assigned initially to the present experiment and received the control risk appraisal case, while others were assigned initially to a second experiment and received a different risk appraisal case. Both cases were split into one-half replicates and upon completion of the first half-replicate the percent of explained risk assessment variance attributable to an hypothesized interaction was calculated for each subject. This procedure, performed automatically by the computer program controlling stimuli presentation, required less than 3 seconds. When the percent was less than the criterion value, the subject next completed a one-half fractional replication from the other experiment (i.e., those initially assigned to experiment one switched to experiment two and vice-versa). Alternatively, when this percent was greater than the criterion value, the subjects next completed the third experiment. This subject assignment procedure could produce a conservative bias (with respect to the hypotheses) for results reported in this study. Such conservatism arises because subjects who were assigned initially to experiment two and who were configural on that experiment's case next completed experiment three (rather than the present study), while subjects who were not configural next completed the present study's case. Thus, proportions of auditors who are configural for the control risk case in the present study may be understated.

REFERENCES

American Institute of Certified Public Accountants, "Audit Risk and Materiality in Conducting an Audit," Statement on Auditing Standards No. 47 (AICPA, 1983).

American Institute of Certified Public Accountants, "Consideration of the Control Structure In a Financial Statement Audit," Statement on Auditing Standards No. 55 (AICPA, 1989).

Anderson, N. H. Foundations of Information Integration Theory (New York: Academic Press, 1981).

Anderson, N. H. Methods of Information Integration Theory (New York: Academic Press, 1982).

Ashton, R. H., "An Experimental Study of Internal Control Judgments," Journal of Accounting Research (Spring 1974), pp. 143-157.

Ashton, R. H., Human Information Processing in Accounting (Sarasota, FL: American Accounting Association, 1982).

Ashton, R. H., Research in Audit Decision Making: Rationale, Evidence, And Implications (Vancouver, British Columbia: Canadian Certified General Accountant's Research Foundation, 1983).

Ashton, R. H. and P. R. Brown, "Descriptive Modeling of Auditors' Internal Control Judgments: Replication and Extension," Journal of Accounting Research (Spring 1980), pp. 269-277.

Ashton, R. H. and S. S. Kramer, "Students as Surrogates in Behavioral Accounting Research: Some Evidence," Journal of Accounting Research (Spring 1980), pp. 1-15.

Biggs, S.F. and T.J. Mock, "An Investigation of Auditor Decision Processes in the Evaluation of Internal Controls and Audit Scope Decisions," Journal of Accounting Research (Spring 1983), pp. 234-245.

Bodnar, G., "Reliability Modeling of Internal Control Systems, "The Accounting Review (October 1975), pp. 747-757.

Brown, P. R., "Independent Auditor Judgment in the Evaluation of Internal Audit Functions," Journal of Accounting Research (Autumn 1983), pp. 444-455.

Camerer, C. F., "Fitting Linear Models to Interactive Data When Variables are Intercorrelated," Unpublished Manuscript, The University of Pennsylvania, 1984.

Camerer, C. F., "MCPL Learning of Disordinal Interactions, and the Validity of Expert Judgment," Unpublished Manuscript, The University of Pennsylvania, 1987.

Colbert, J.L., "Inherent Risk: An Investigation of Auditors' Judgments," Accounting, Organizations, and Society, 1988, Vol. 13, No. 2, pp. 111-122.

Cushing, B. E., "A Mathematical Approach to the Analysis and Design of Internal Control Systems," The Accounting Review (January 1974), pp. 24-41.

Dawes, R.M., Rational Choice in an Uncertain World (Orlando: Harcourt Brace Jovanovich, 1988).

Dawes, R. M. and B. Corrigan, "Linear Models in Decision Making," Psychological Bulletin (January 1974), pp. 95-106.

Deloitte, Haskins & Sells, Control Set: Internal Accounting Control Study and Evaluation Techniques (New York: DH & S, 1978).

Edgell, S. E., "Higher Order Configural Information Processing in Nonmetric Multiple-Cue Probability Learning," Organizational Behavior and Human Performance (1980), pp. 1-14.

Edgell, S. E., "Delayed Exposure to Configural Information in Nonmetric Multiple-Cue Probability Learning," Organizational Behavior and Human Performance (1983), pp. 55-65.

Einhorn, H.J., D. N. Kleinmuntz and B. Kleinmuntz, "Linear Regression and Process Tracing Methods of Judgments," Psychological Review (1979), pp. 465-485.

Felix, W.L. and M.S. Niles, "Research In Internal Control Evaluation," Auditing: A Journal of Practice & Theory (Spring 1988), pp. 43-60.

Frederick, D. and R. Libby, "Expertise and Auditors' Judgments of Conjunctive Events," Journal of Accounting Research (Autumn 1986), pp. 270-290.

Goldberg, L. R., "Simple Models or Simple Processes? Some Research on Clinical Judgments," American Psychologist (July 1968), pp. 483-496.

Grimlund, R. A., "An Integration of Internal Control System and Account Balance Evidence," Journal of Accounting Research, (Autumn 1982, Part I), pp. 316-342.

Hall, C., P. Yetton and I. Zimmer, "The Assessment of Payroll Internal Control Systems and Auditors' Experience, Tolerance of Ambiguity, and Dogmatism, "Australian Journal of Management (June 1982), pp. 49-60.

Hamilton, R. E. and W. F. Wright, "Internal Control Judgments and Effects of Experience: Replications and Extensions," Journal of Accounting Research (Autumn 1982, Part II), pp. 756-765.

Hammond, K. R. and D. A. Summers, "Cognitive Dependence on Linear and Nonlinear Cues," Psychological Review (May 1965), pp. 215-234.

Hitt, M.A. and S. H. Barr, "Managerial Selection Decision Models: Examination of Configural Cue Processing," Journal of Applied Psychology (1989), pp. 53-61.

Hoffman, P. J., P. Slovic and L. G. Rorer, "An Analysis-of-Variance Model for the Assessment of Configural Cue Utilization in Clinical Judgment," Psychological Bulletin (May 1968), pp. 338-349.

Kerlinger, F. N., Foundations of Behavioral Research, 3rd Edition (New York: Holt, Rinehart and Winston, 1986).

Leon, M., G. C. Oden, and N. H. Anderson, "Functional Measurement of Social Values," Journal of Personality and Social Psychology (1973), pp. 301-310.

Libby, R., "The Use of Simulated Decision Makers in Information Evaluation," The Accounting Review (July 1975), pp. 475-489.

Libby, R., Accounting and Human Information Processing (Englewood Cliffs, NJ: Prentice-Hall, 1981).

Libby, R., J. T. Artman and J. J. Willingham, "Process Susceptibility, Control Risk, and Audit Planning," The Accounting Review (April 1985), pp. 212-230.

Libby, R., and D. Frederick, "Expertise and the Ability to Explain Audit Findings," Unpublished working paper, University of Michigan, 1988.

Meehl, P. E., Clinical Versus Statistical Prediction: A Theoretical Analysis and Review of the Literature (University of Minnesota Press, 1954).

Meehl, P. E., "When Shall We Use Our Heads Instead of the Formula?", Journal of Counseling Psychology (1957), pp. 268-273.

Meehl, P. E., "A Comparison of Clinicians with Five Statistical Methods of Identifying Psychotic MMPI Profiles," Journal of Counseling Psychology (Summer 1959), pp. 102-110.

Meservy, R., A. D. Bailey and P.E. Johnson, " Internal Control Evaluation: A Computational Model of the Review Process," Auditing: A Journal of Practice and Theory (Fall 1986), pp. 44-74.

Reckers, P. M. J. and M. E. Taylor, Consistency in Auditors' Evaluations of Internal Accounting Controls," Journal of Accounting, Auditing and Finance (Fall 1979), pp. 42-55.

Rorer, L., P. J. Hoffman, H. R. Dickman, and P. Slovic, "Configural Judgments Revealed," Proceedings of the 75th Annual American Psychological Association Convention (1967), pp. 195-196.

Schepanski, A., "Test of Theories of Information Processing Behavior in Credit Judgment," The Accounting Review (July 1983), pp. 581-599.

Slovic, P., B. Fischhoff and S. Lichtenstein, "Behavioral Decision Theory," Annual Review of Psychology (1977). pp. 1-39.

Slovic, P. "Analyzing the Expert Judge: A Descriptive Study of a Stockbroker's Decision Processes," Journal of Applied Psychology (August 1969), 255-263.

Slovic, P. and S. Lichtenstein, "Comparison of Bayesian and Regression Approaches to the Study of Information Processing in Judgment," Organizational Behavior and Human Performance (November 1971), pp. 649-744.

Srivastava, R. P., "Auditing Functions for Internal Control Systems with Interdependent Documents and Channels, Journal of Accounting Research (Autumn 1986), pp. 422-426.

Thorndike, E. L., "Fundamental Theorems in Judging Men," Journal of Applied Psychology (June 1918), pp. 67-76.

Trotman, K. T., P. W. Yetton and I. R. Zimmer, "Individual and Group Judgments of Internal Control Systems," Journal of Accounting Research (Spring 1983), pp. 286-292.

Yntema, D.B., and W.S. Torgerson, "Man-Computer Cooperation in Decisions Requiring Common Sense," IEE Transactions on Human Factors in Electronics (1961), pp. 20-26.

EXHIBIT 1

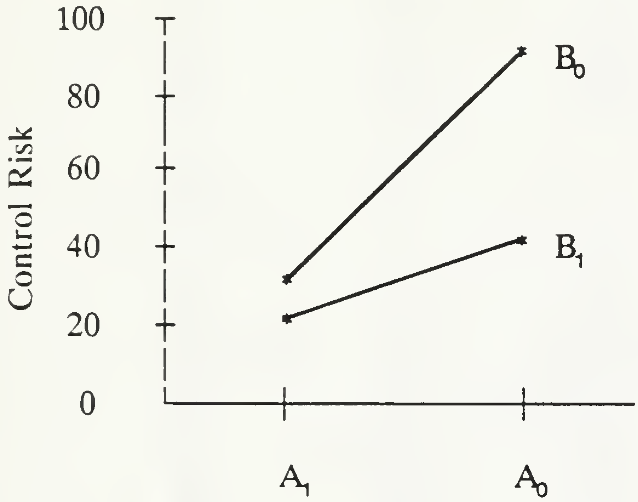
Cash Disbursement Internal Controls Questionnaire

CONTROL QUESTION	YES	NO
1. Are protective writing devices used to inscribe amounts on checks?		
2. Are properly approved vouchers required for check preparation?		
3. Are all check signers designated by the Board of Directors?		
4. Are the primary check signers independent of:		
a. Purchasing and those requesting expenditures?		
b. Persons approving vouchers?		
c. Persons processing and recording cash disbursements?		
5. Is an independent second check signer required who carefully scrutinizes the supporting documentation?		
6. Does internal audit investigate payments made to payees not on an independently approved payee listing?		

FIGURE 1

ANOVA Representations of Configural Information Processing

Panel A: Negative Ordinal Interaction (Compensating Controls)



Panel B: Positive Ordinal Interaction (Amplifying Controls)

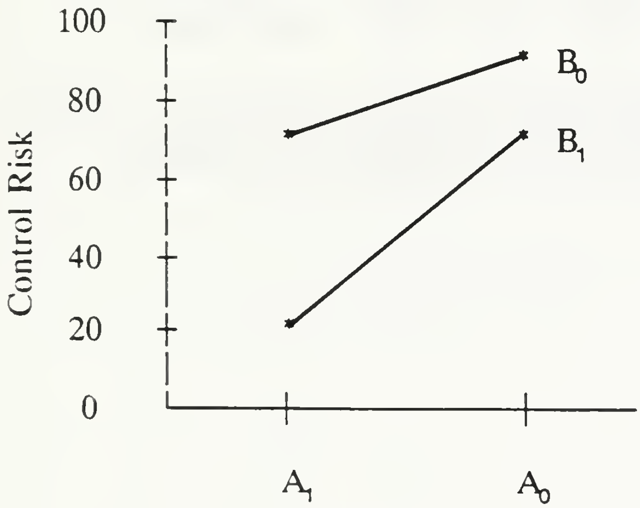


FIGURE 2

Simulations of Configural Information Processing
Within a Two-Cue Context

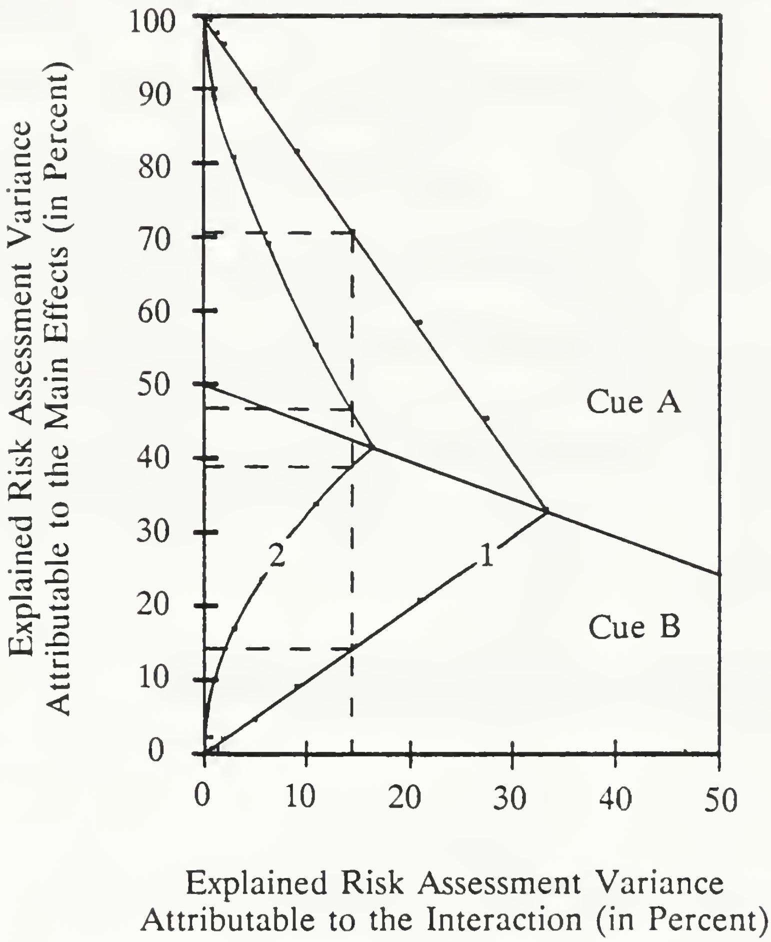


TABLE 1

Cash Disbursements Internal Controls Case: Above-Criterion Proportion of Explained Judgment Variance Means and Frequencies For Possible Model Sources

Source	Mean	Std.Dev.	Freq.
A	12.16	9.37	37
B	11.75	8.36	46
C	43.60	22.89	92
D	23.39	16.68	80
E	14.93	10.77	64
Total Main Effects	83.20	7.95	94
AB	6.34	1.83	7
AC	6.27	2.02	8
AD	6.29	3.62	7
AE	6.12	1.66	11
BC	7.52	3.88	12
BD	5.80	1.92	6
BE	6.18	2.70	5
CD	7.41	3.24	27
CE	6.92	2.54	12
DE	7.13	2.79	10
Total Interactions	10.69	6.47	67

NOTE: Sources keyed to control numbers in Exhibit 1: A = 1; B = 3; C = 4; D = 5; and E = 6.

TABLE 2

Risk Assessments Within the Hypothesized Interactions

	Interaction Levels			
	YY	YN	NY	NN
Compensating (negative ordinal):				
Mean	18.55	26.57	36.11	65.54
Std. Dev.	10.87	10.35	12.19	10.34
N	19	19	19	19
Amplifying (positive ordinal):				
Mean	25.86	52.01	60.38	65.38
Std. Dev.	18.52	19.10	20.52	22.30
N	20	20	20	20

NOTE: The interactions are those hypothesized (CD and CE in Table 1), and the levels are: YY = both internal controls are present; YN = separation-of-duties is present, but the preventive/detective control is not; NY = the preventive/ detective control is present, but separation-of-duties is not; and NN = neither separation-of-duties nor the preventive/detective control is present.

TABLE 3

Judgment Model Predictions of Risk Assessments:
Compensating (Negative Ordinal) Interactions

Overall (n=19)

Judgment Model	YY	YN	NY	NN
		Interaction Levels		
Full	18.55	26.57	36.11	65.54
Reduced	13.19	31.92	41.46	60.19
Difference	-5.35	5.35	5.35	-5.35

Judgment Model Difference Quartiles (n=5)

Quartile	Judgment Model	YY	YN	NY	NN
			Interaction Levels		
1	Full	12.55	23.65	33.25	74.50
	Reduced	5.01	31.19	40.79	66.96
	Difference	-7.54	7.54	7.54	-7.54
2	Full	16.75	25.65	34.15	65.20
	Reduced	11.21	31.19	39.69	59.66
	Difference	-5.54	5.54	5.54	-5.54
3	Full	16.88	24.00	33.60	59.10
	Reduced	12.28	28.59	38.19	54.51
	Difference	-4.59	4.59	4.59	-4.59
4	Full	30.38	34.56	45.25	62.81
	Reduced	27.03	37.91	48.59	59.47
	Difference	-3.34	3.34	3.34	-3.34

NOTES: The interactions are those hypothesized (CD and CE in Table 1), and their levels are the same as in Table 2. The prediction differences are determined by subtracting the full model's risk assessment predictions from those of the reduced model: thus, a negative sign implies that the reduced model is underestimating risk relative to the full model.

TABLE 4

Judgment Model Predictions of Risk Assessments:
Amplifying (Positive Ordinal) Interactions

Overall (n=20)

Judgment Model	YY	YN	NY	NN
		Interaction Levels		
Full	25.95	51.93	60.46	65.29
Reduced	31.23	46.64	55.17	70.58
Difference	5.29	-5.29	-5.29	5.29

Judgment Model Difference Quartiles (n=5)

Quartile	Judgment Model	YY	YN	NY	NN
			Interaction Levels		
1	Full	9.25	50.75	71.70	78.30
	Reduced	17.98	42.03	62.98	87.03
	Difference	8.73	-8.73	-8.73	8.73
2	Full	34.15	58.15	66.95	68.50
	Reduced	39.76	52.54	61.34	74.11
	Difference	5.61	-5.61	-5.61	5.61
3	Full	33.65	61.40	62.05	72.50
	Reduced	37.98	57.08	57.73	76.83
	Difference	4.33	-4.33	-4.33	4.33
4	Full	26.74	37.41	41.14	41.86
	Reduced	29.23	34.93	38.65	44.35
	Difference	2.49	-2.49	-2.49	2.49

NOTES: The interactions are those hypothesized (CD and CE in Table 1), and their levels are the same as in Table 2. The prediction differences are determined by subtracting the full model's risk assessment predictions from those of the reduced model: thus, a negative sign implies that the reduced model is underestimating risk relative to the full model.